Nonstructural Analysis for Flood Damage Reduction in HEC-FDA

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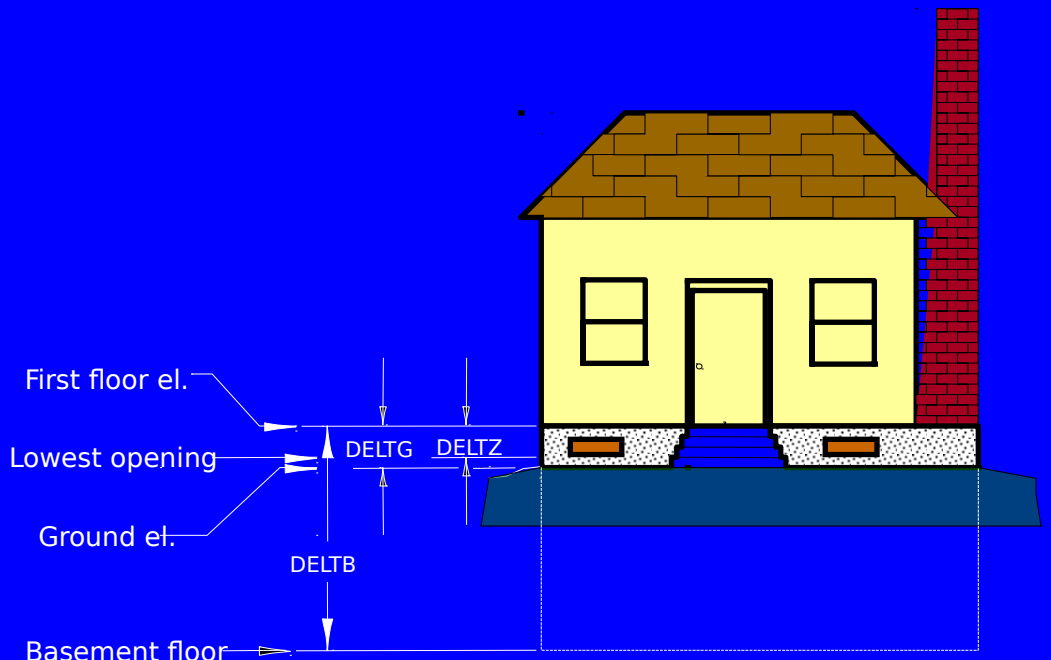
OBJECTIVES

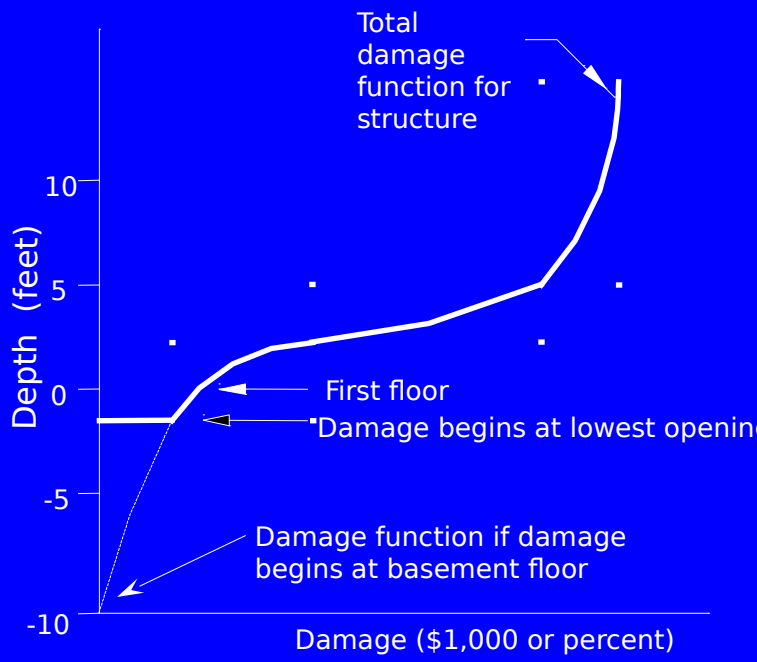
- To provide Corps field offices with a method that integrates existing capabilities with analysis and display enhancements for nonstructural measures
- Incorporate methodology into HEC-FDA, Flood Damage Reduction Analysis, software
- Provide documentation and PROSPECT training
- Provide support

DESCRIPTION OF WORK

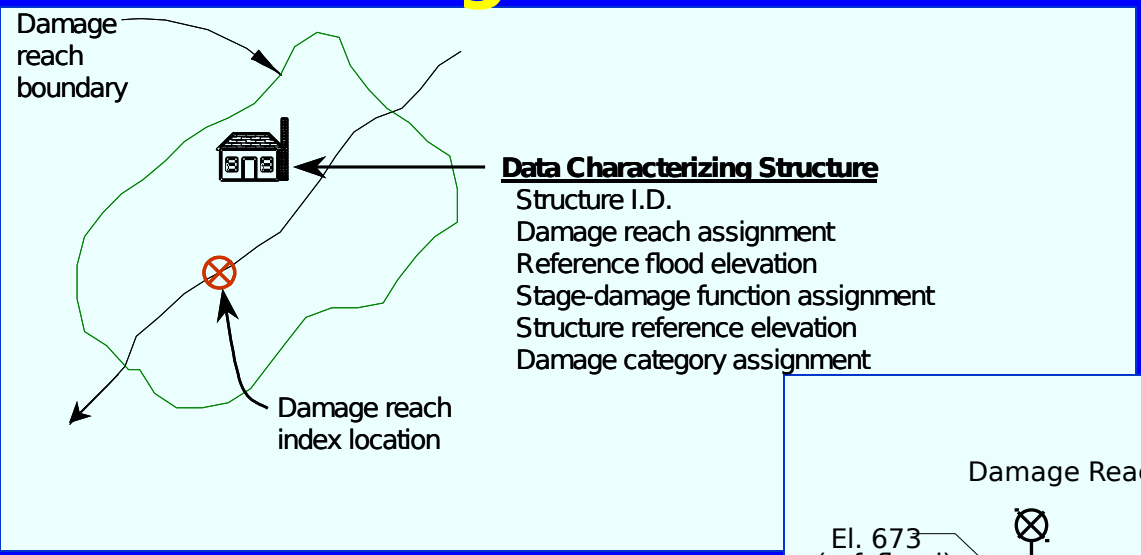
- Design new methodology for nonstructural analysis
  - Flood proofing
  - Raising of structures
  - Relocation of structures
  - Ring Levees
  - Floodplain Management/Regulations
  - Flood Warning Preparedness Plans

Calculating depth-damage at a Structure



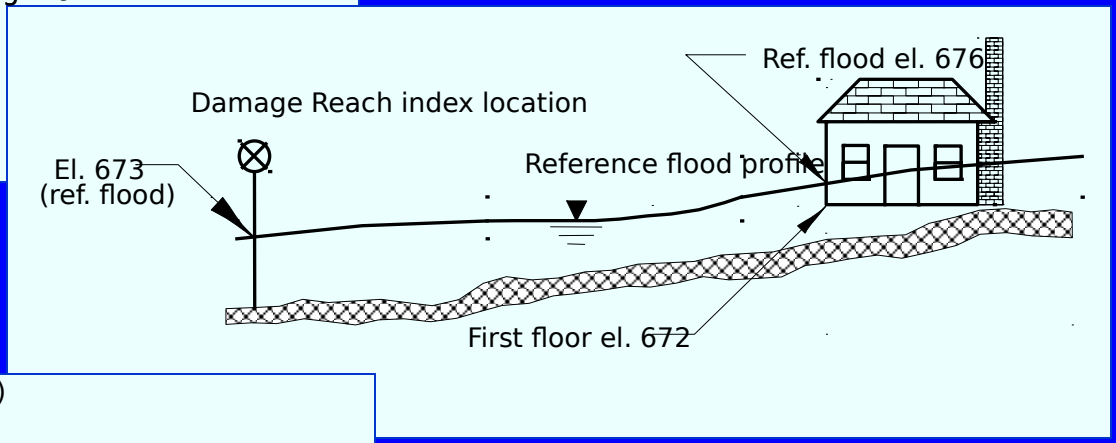


Translation of Structure Elevation-Damage Function to Index Location



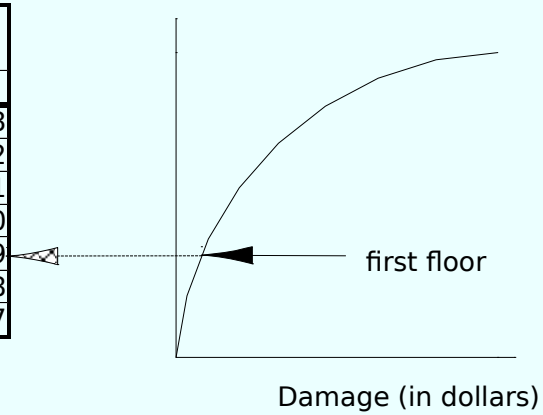
Data Characterizing Structure

- Structure I.D.
- Damage reach assignment
- Reference flood elevation
- Stage-damage function assignment
- Structure reference elevation
- Damage category assignment



Elevation scale adjusted -3 feet (676-673) for slope in reference flood water surface profile

Values at Structure		Values at Index
Stage	Elevation	Elevation
4	676	673
3	675	672
2	674	671
1	673	670
0	672	669
-1	671	668
-2	670	667



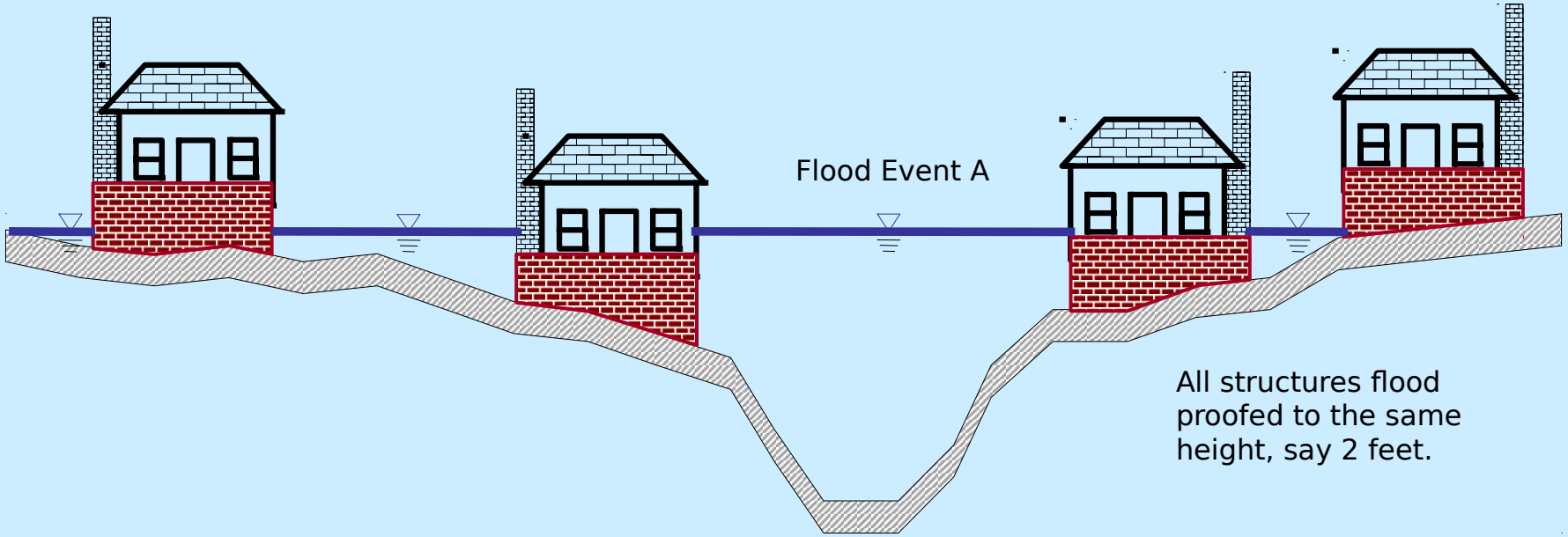
Procedures that will be used in HEC-FDA

- Nonstructural measures will be applied in two modes:
  - The Economics / Structure inventory mode where the measures are permanently stored in the database and are used to compute stage-damage for the selected plan / year for plan evaluation;
  - The interactive mode in which calculations are done on an ad-hoc basis for information purposes only. The user may save nonstructural parameters for use in the structure inventory mode by assigning them to a plan / year.

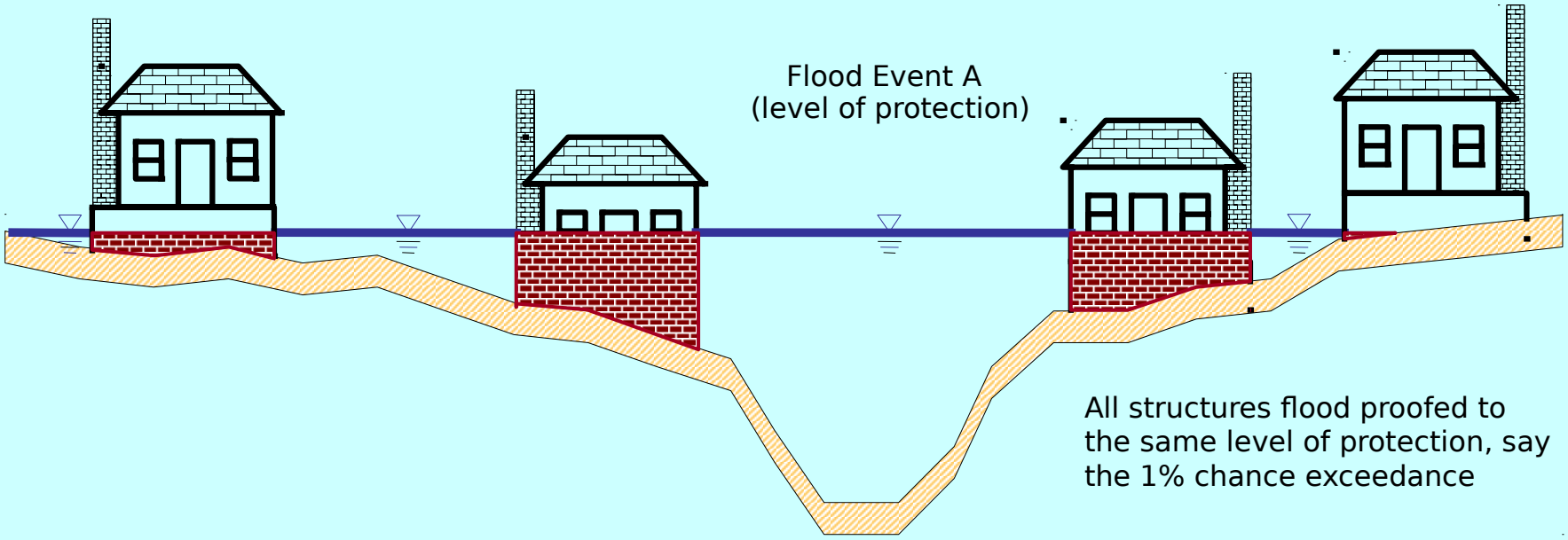
Nonstructural Calculations

- Nonstructural measures are applied using a reference elevation at the structure. This reference elevation can be one of three elevations:
  - The first floor
  - The ground
  - The zero damage point (the elevation at which damage begins)
- Nonstructural stage criteria are of two types:
  - A fixed height (e.g. raise a structure 3 feet).
  - A target elevation defined by exceedance probability, inundation layer, or stage. The user enters the exceedance probability or inundation layer and HEC-FDA will compute the associated elevation at the structure using either:
    - Inundation layers or
    - The discharge-probability, stage-discharge functions, and water surface profiles.
    - Stage at the index location and water surface profiles or inundation layers.
    - Stage at the structure.

Flood Proofing To Specified Height Above Zero Damage Elevation

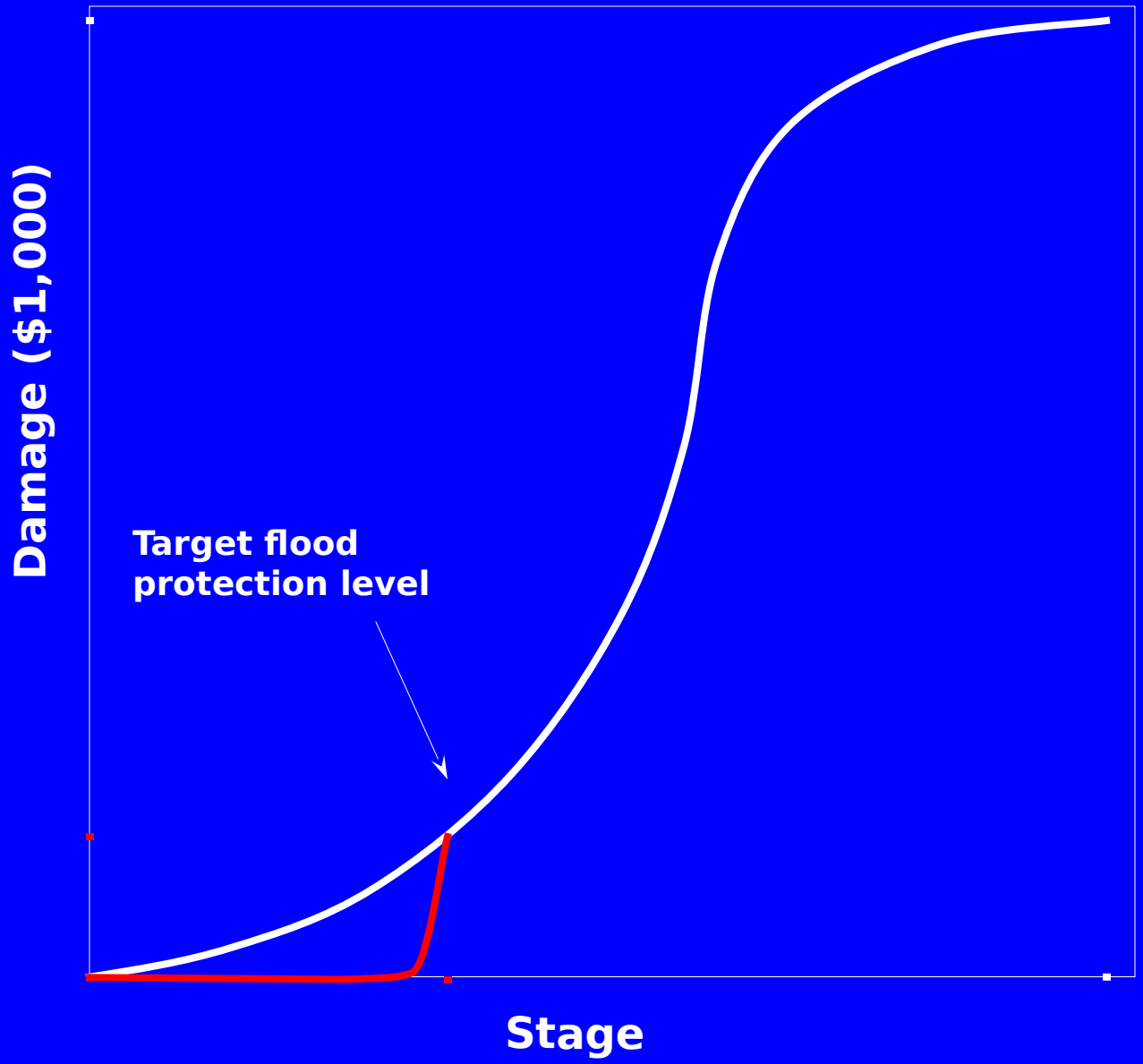


Flood Proofing To Specified Flood Target Level

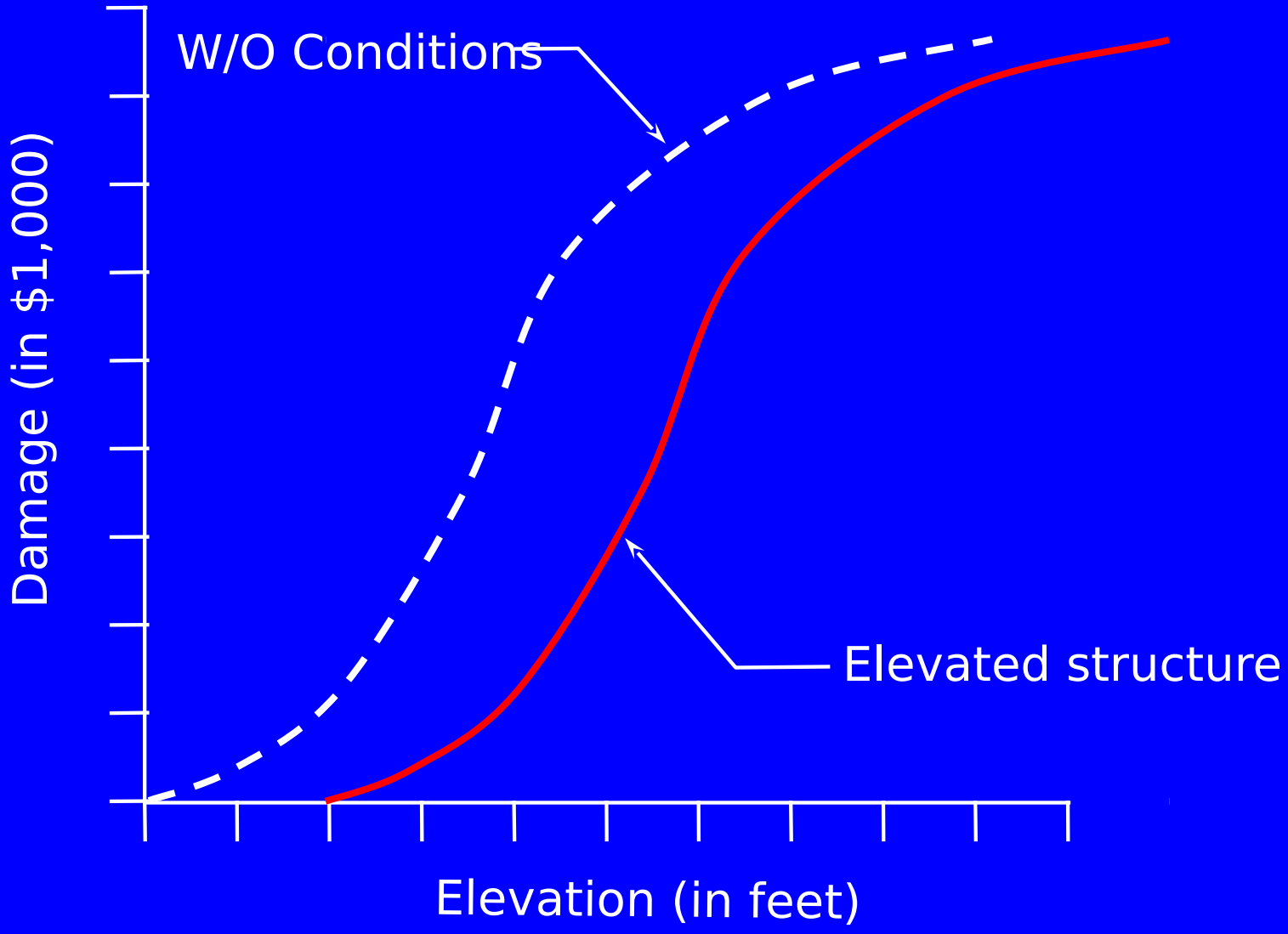

Flood Event A
(level of protection)
All structures flood proofed to
the same level of protection, say
the 1% chance exceedance

Note: shaded area represents amount of flood proofing for each structure

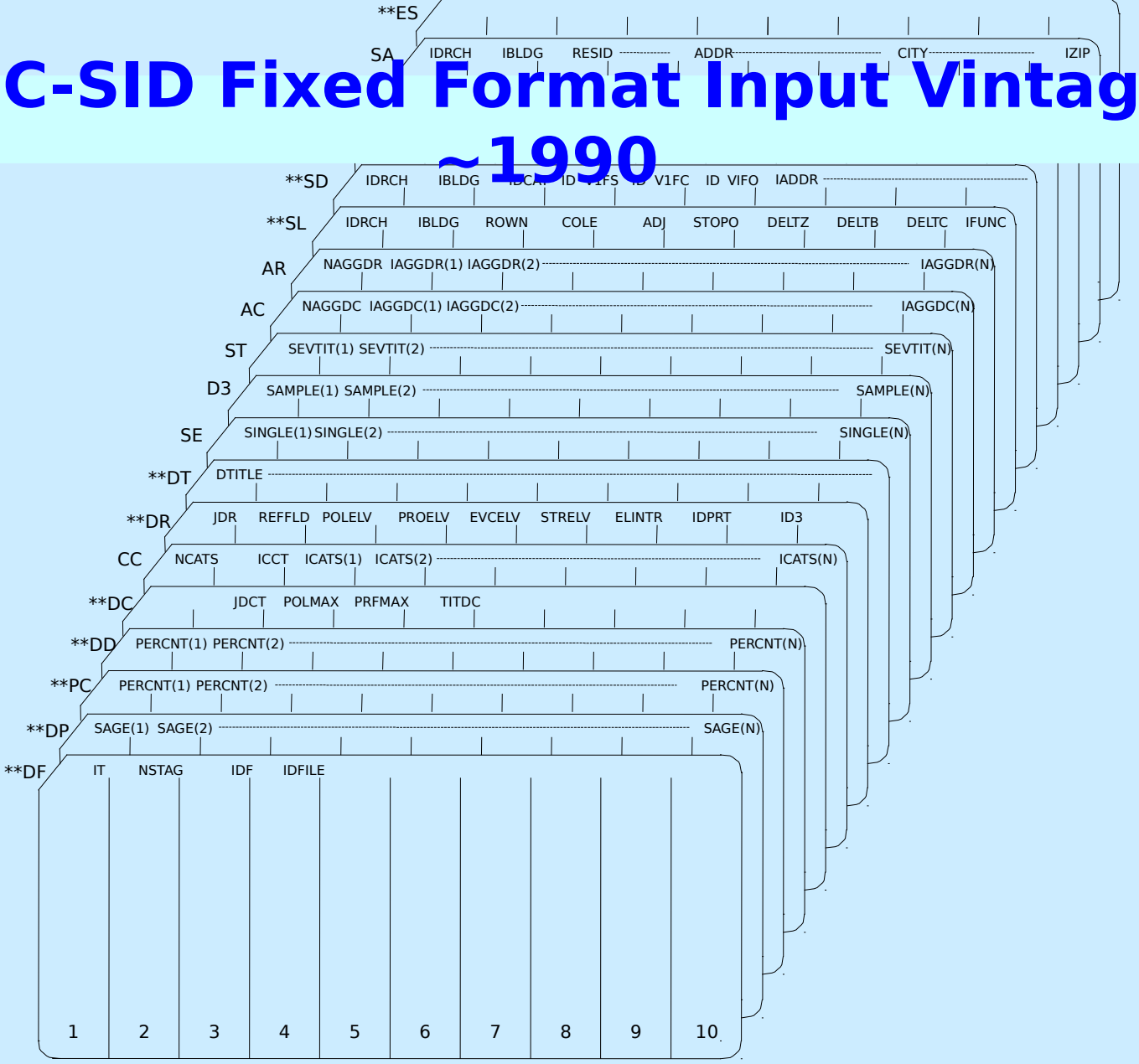
Floodproofing a Structure



Raise Existing Structure and Contents



HEC-SID Fixed Format Input Vintage ~1990


**ES
SA IDRCH IBLDG RESID ADDR CITY IZIP
**SD IDRCH IBLDG IDCAT ID V1FS ID V1FC ID VIFO IADDR
**SL IDRCH IBLDG ROWN COLE ADJ STOPO DELTZ DELTB DELTC IFUNC
AR NAGGDR IAGGDR(1) IAGGDR(2) IAGGDR(N)
AC NAGGDC IAGGDC(1) IAGGDC(2) IAGGDC(N)
ST SEVTIT(1) SEVTIT(2) SEVTIT(N)
D3 SAMPLE(1) SAMPLE(2) SAMPLE(N)
SE SINGLE(1) SINGLE(2) SINGLE(N)
**DT DTITLE
**DR JDR REFFLD POLELV PROELV EVCELV STRELV ELINTR IDPRT ID3
CC NCATS ICCT ICATS(1) ICATS(2) ICATS(N)
**DC JDCT POLMAX PRFMAX TITDC
**DD PERCNT(1) PERCNT(2) PERCNT(N)
**PC PERCNT(1) PERCNT(2) PERCNT(N)
**DP SAGE(1) SAGE(2) SAGE(N)
**DF IT NSTAG IDF IDFILE
1 2 3 4 5 6 7 8 9 10

Record Field Numbers

** Required Record

HEC-SID “Batch” Output Vintage ~1990

TEST 4 - RAISING , FLOOD PROOFING , AND RELOCATION OF STRUCTURES
SID - STRUCTURE INVENTORY OF DAMAGE
MARCH 1989

Damage Reach DR2
Content Adjustment Summary Table

Policy Summary

The contents for the following buildings were raised

Building	amount raised
RES01	.40

The contents for 1 buildings were raised a total of .40 feet

Flood Proofing Summary

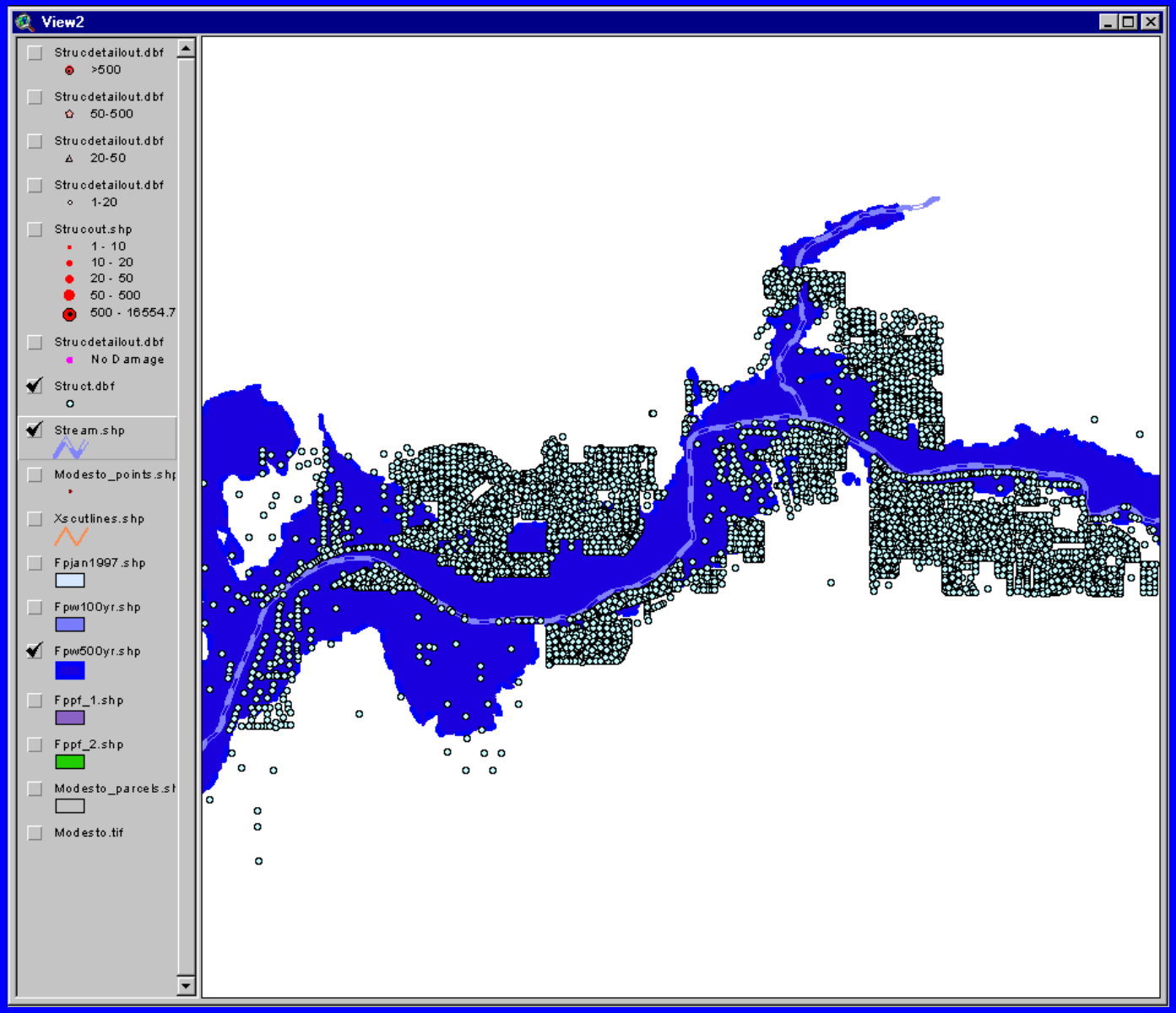
The contents of the following buildings were floodproofed

Building	amount of flood proofing
RES01	1.00
RES02	2.50
COM01	1.10

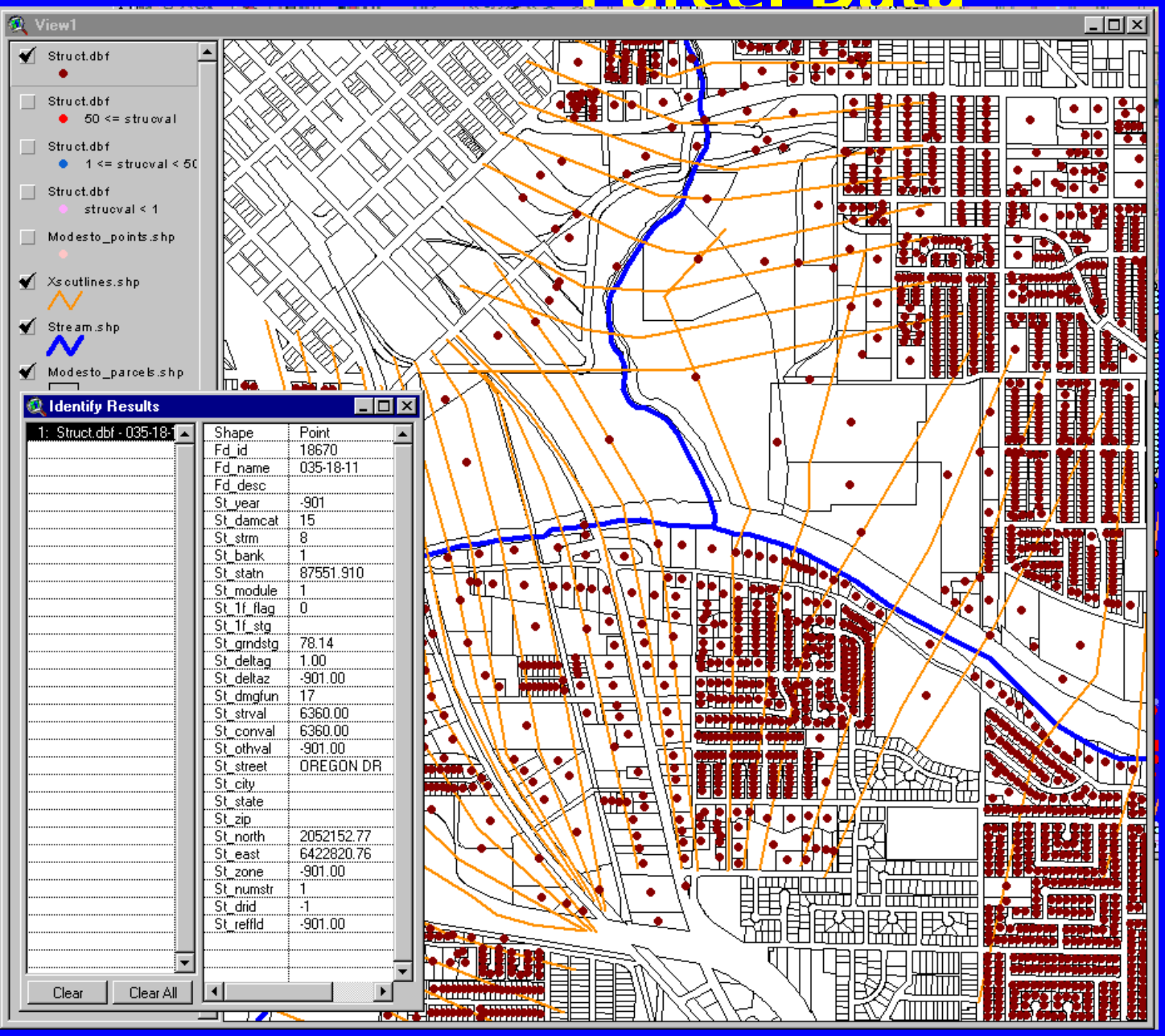
The contents for 3 buildings
were flood proofed a total of 4.60 feet

Structure Inventory (Modesto)

Windows To Property Data, First American Real Estate

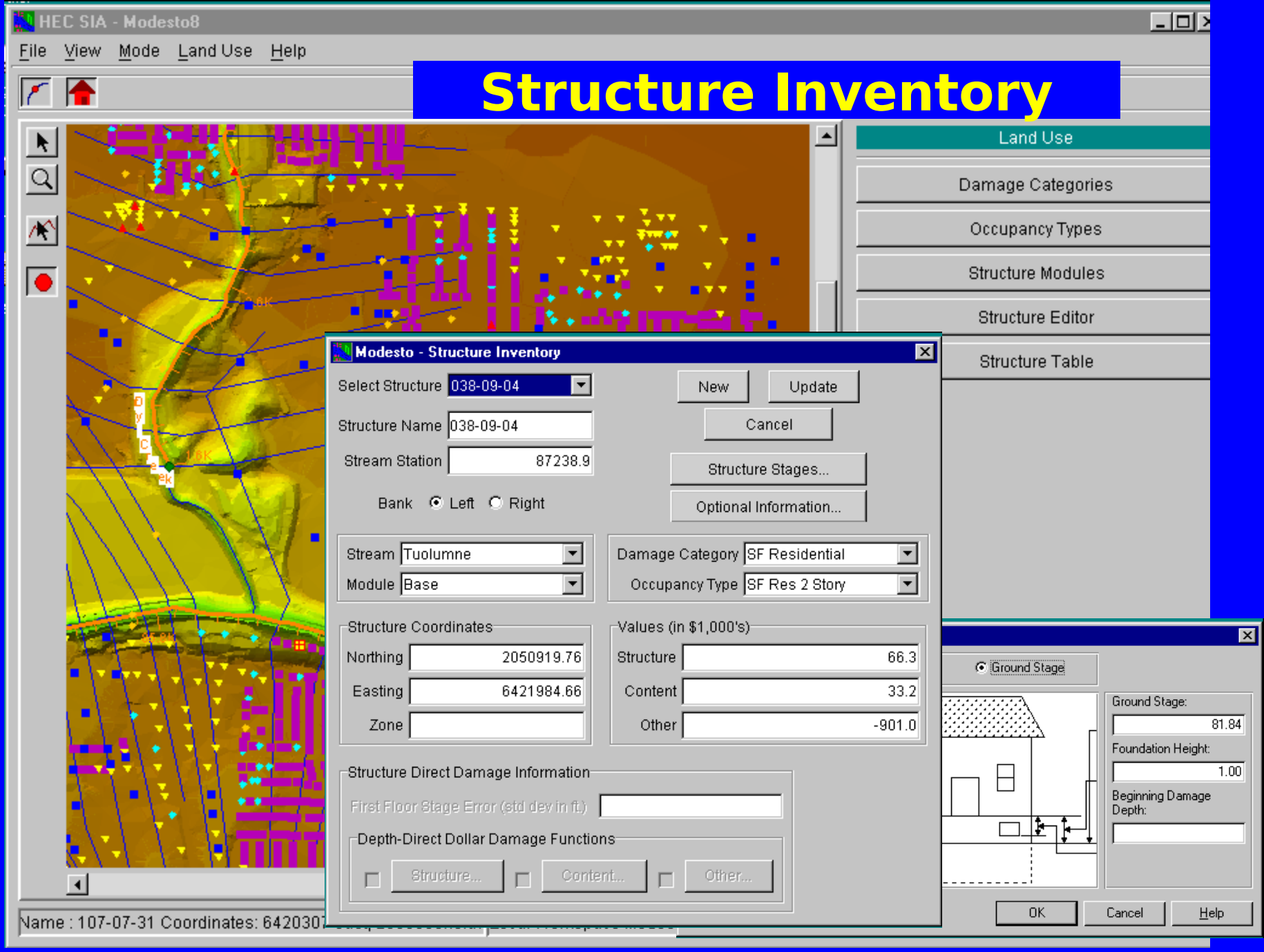


Parcel Data

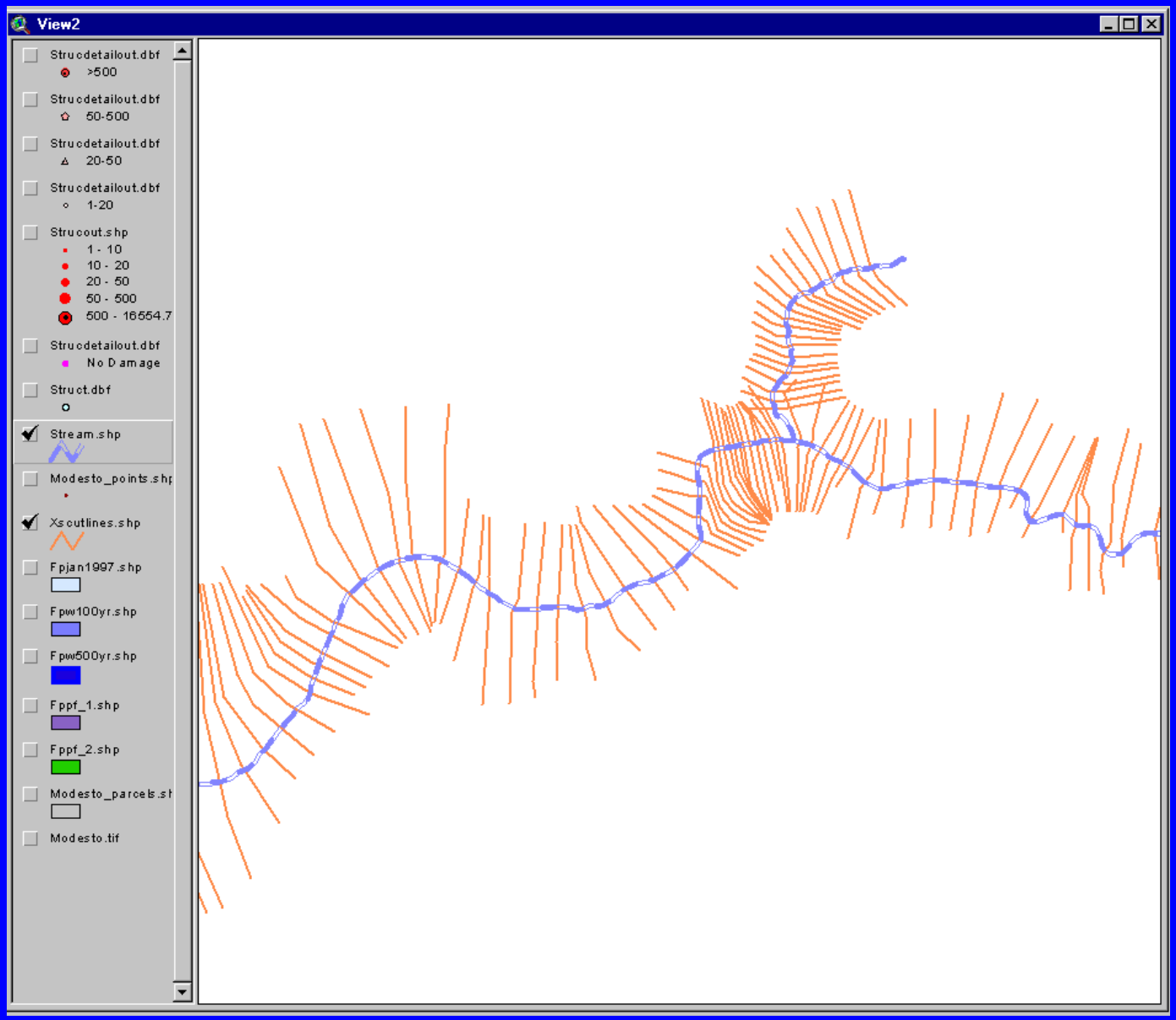


- Digitized Parcels
- Centroid of parcel computed using ArcView
- Ground Elevation of centroid computed from DEM using ArcView

Structure Inventory

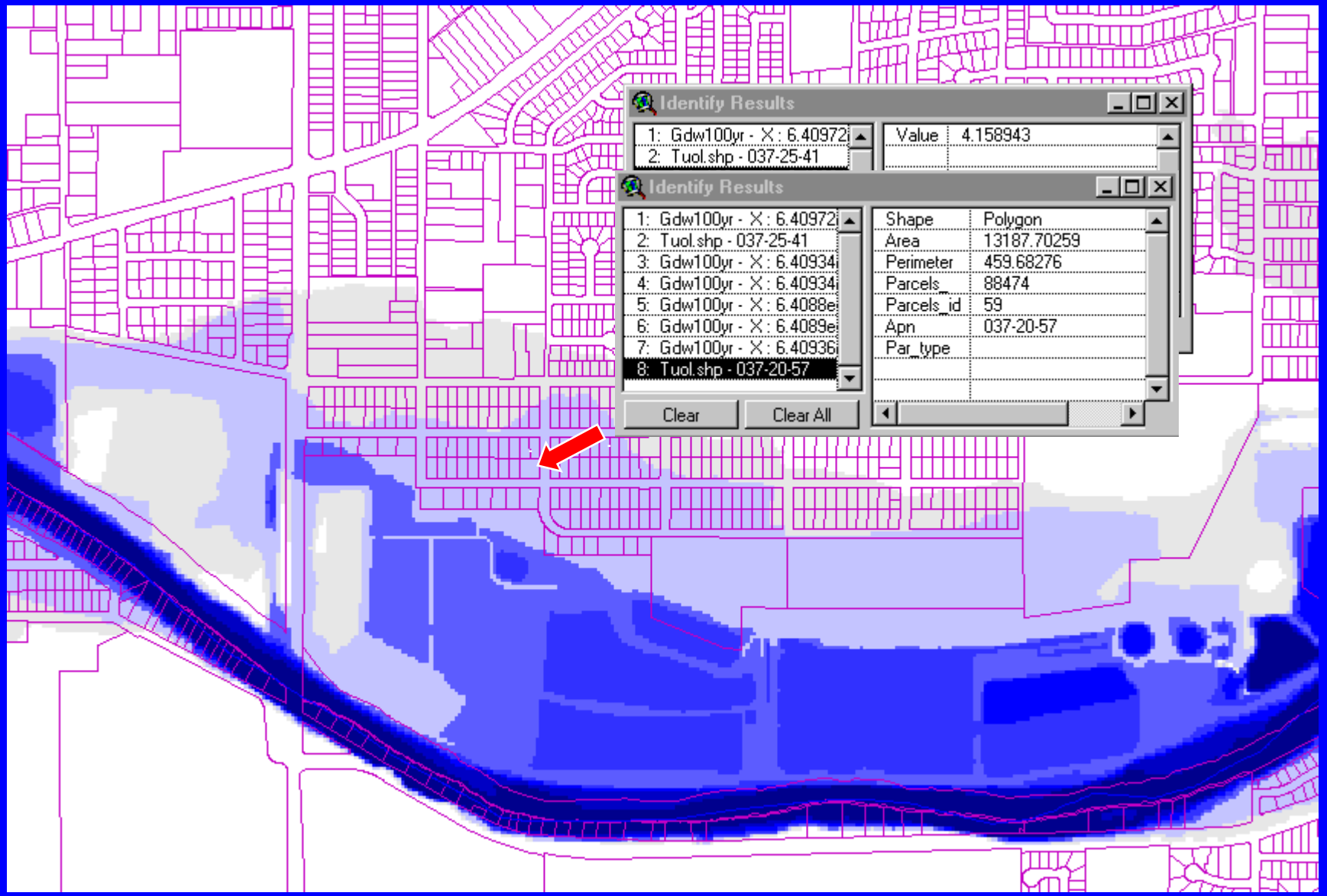


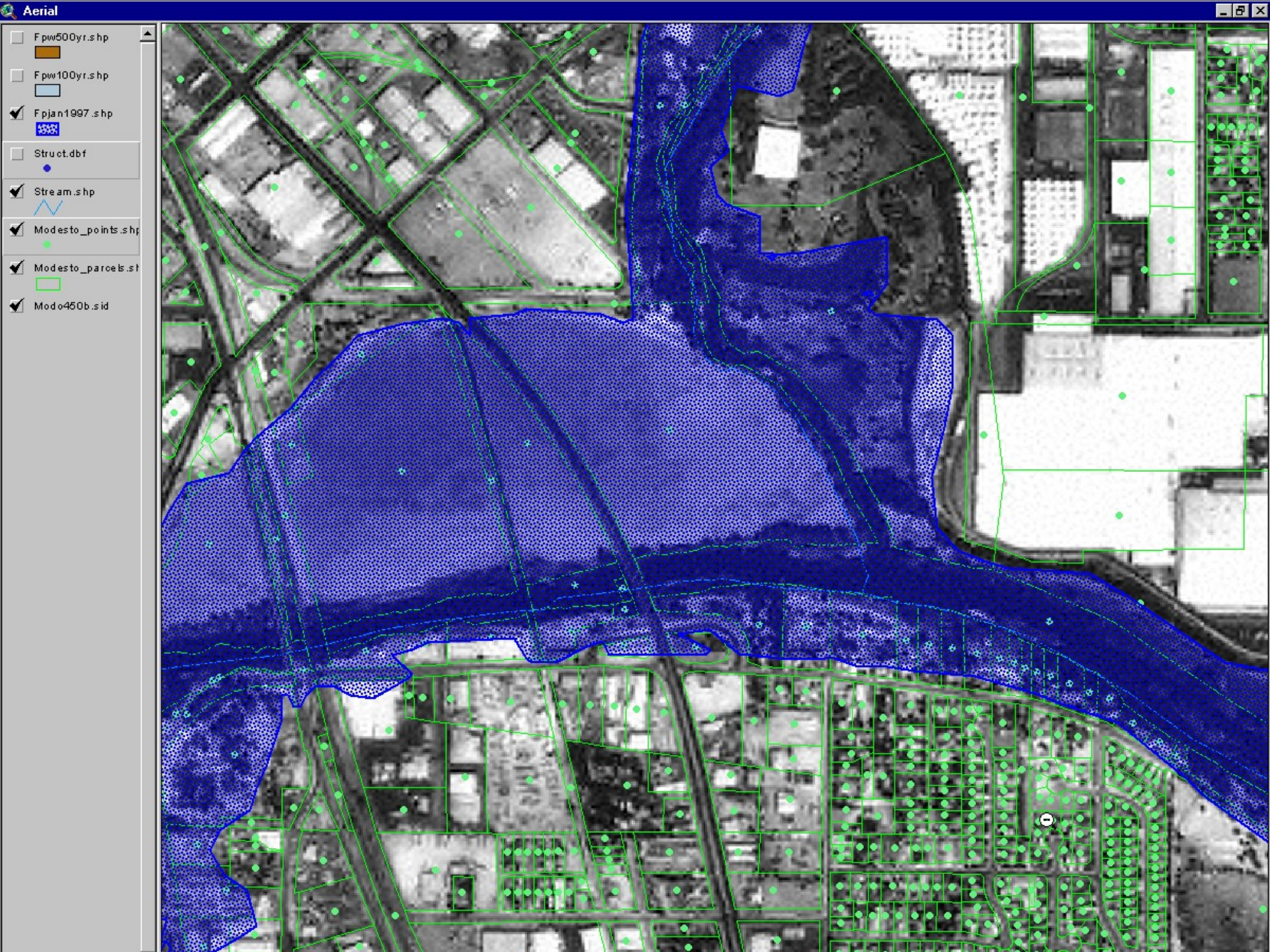
HEC-RAS & GEO-RAS

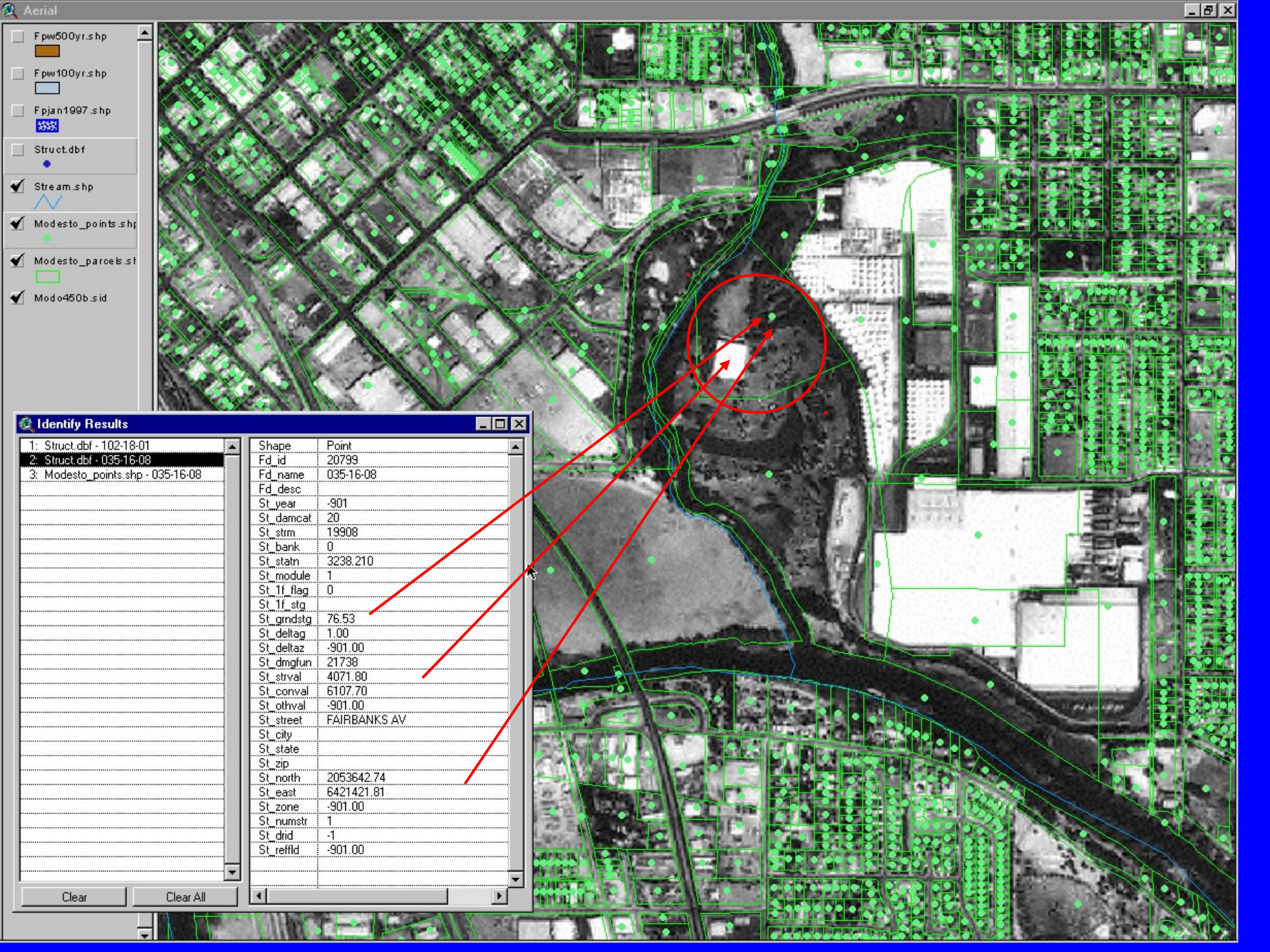


Inundation Mapping

100 Year Floodplain - Depth at a parcel




Aerial
Fpw500yr.shp
Fpw100yr.shp
Fpjan1997.shp
Struct.dbf
Stream.shp
Modesto_points.shp
Modesto_parcels.sh
Modo450b.sid


Aerial
Fpw500yr.shp
Fpw100yr.shp
Fpjan1997.shp
Struct.dbf
Stream.shp
Modesto_points.shp
Modesto_parcels.sh
Modo450b.sid
Identify Results
1: Struct.dbf - 102-18-01
2: Struct.dbf - 035-16-08
3: Modesto_points.shp - 035-16-08
Shape Point
Fd_id 20799
Fd_name 035-16-08
Fd_desc
St_year -901
St_damcat 20
St_strm 19908
St_bank 0
St_statn 3238.210
St_module 1
St_1f_flag 0
St_1f_stg
St_grndstg 76.53
St_deltag 1.00
St_deltaz -901.00
St_dmgfun 21738
St_strval 4071.80
St_conval 6107.70
St_othval -901.00
St_street FAIRBANKS AV
St_city
St_state
St_zip
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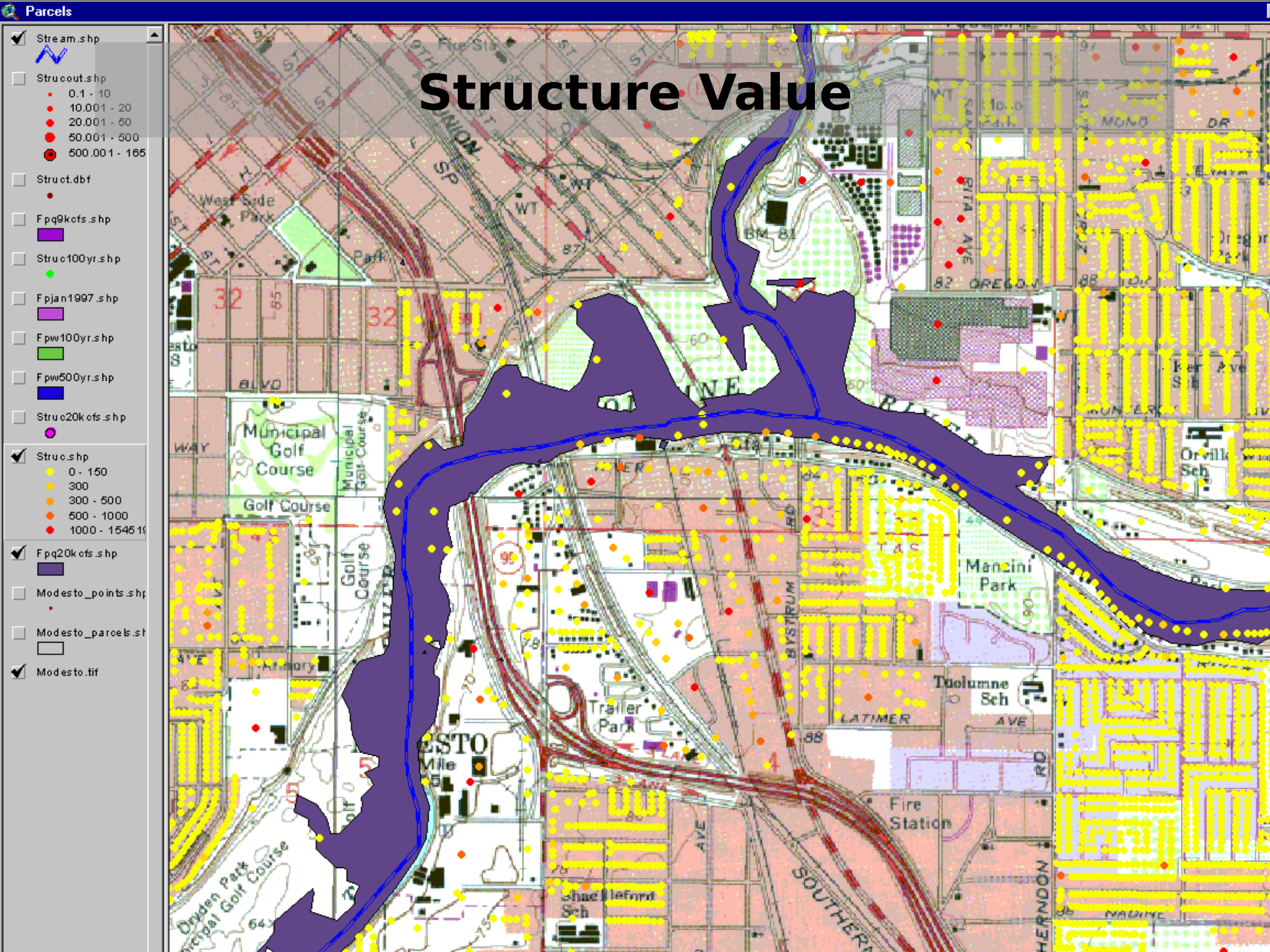
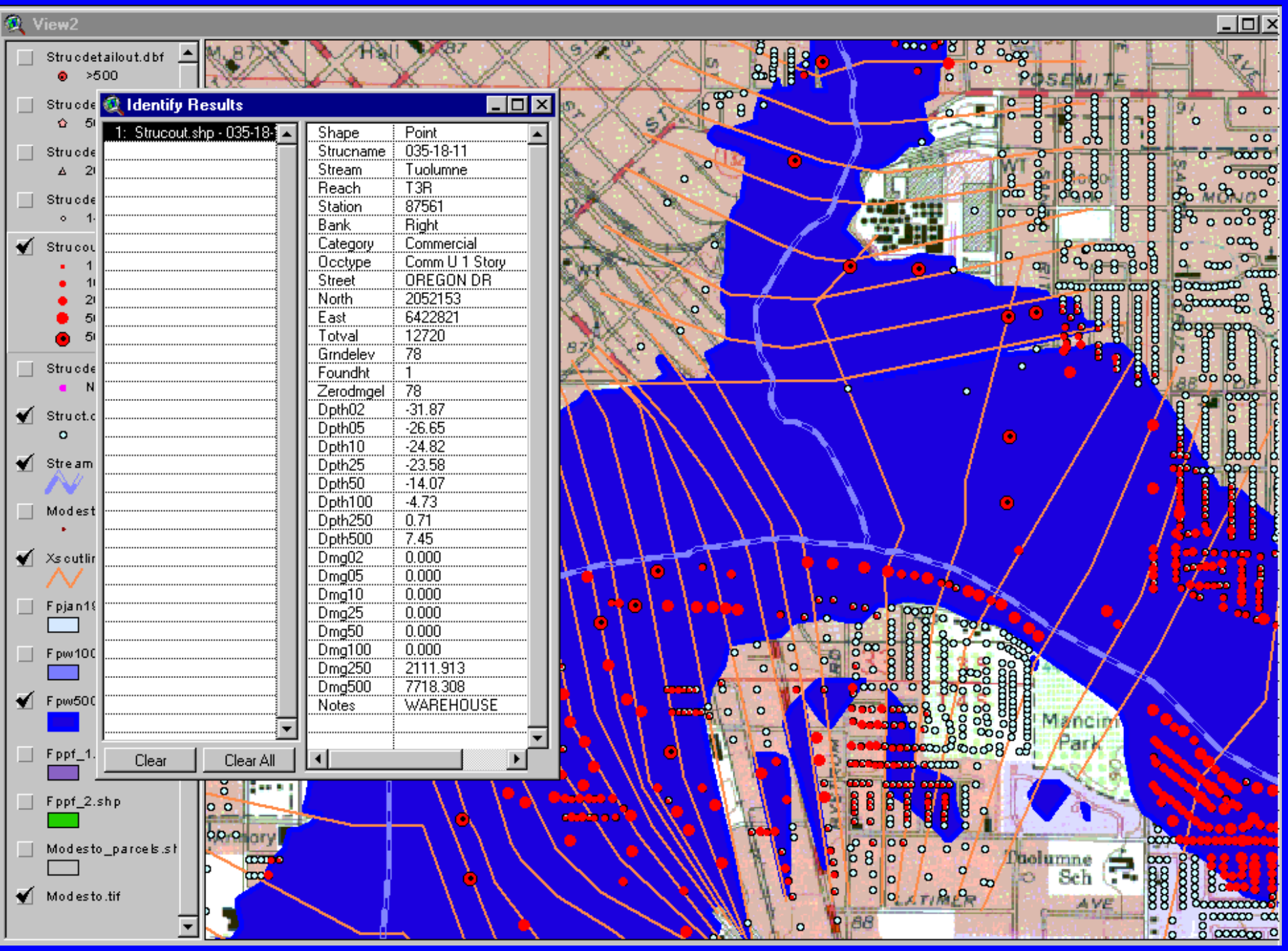
Clear All


Parcels
Stream.shp
Strucout.shp
0.1 - 10
10.001 - 20
20.001 - 50
50.001 - 500
500.001 - 165
Struct.dbf
Fpq9kcfs.shp
Struc100yr.shp
Fpjan1997.shp
Fpw100yr.shp
Fpw500yr.shp
Struc20kcfs.shp
Struc.shp
0 - 150
300
300 - 500
500 - 1000
1000 - 154519
Fpq20kcfs.shp
Modesto_points.shp
Modesto_parcels.sh
Modesto.tif
Structure Value
Municipal Golf Course
Golf Course
Mancini Park
Tuolumne Sch
Fire Station
Trailer Park
Dryden Park Municipal Golf Course
Shackleford Sch
Orville Sch
West Side Park
LATIMER AVE
SOUTHERN PACIFIC


View2
Strucdetailout.dbf
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Identify Results
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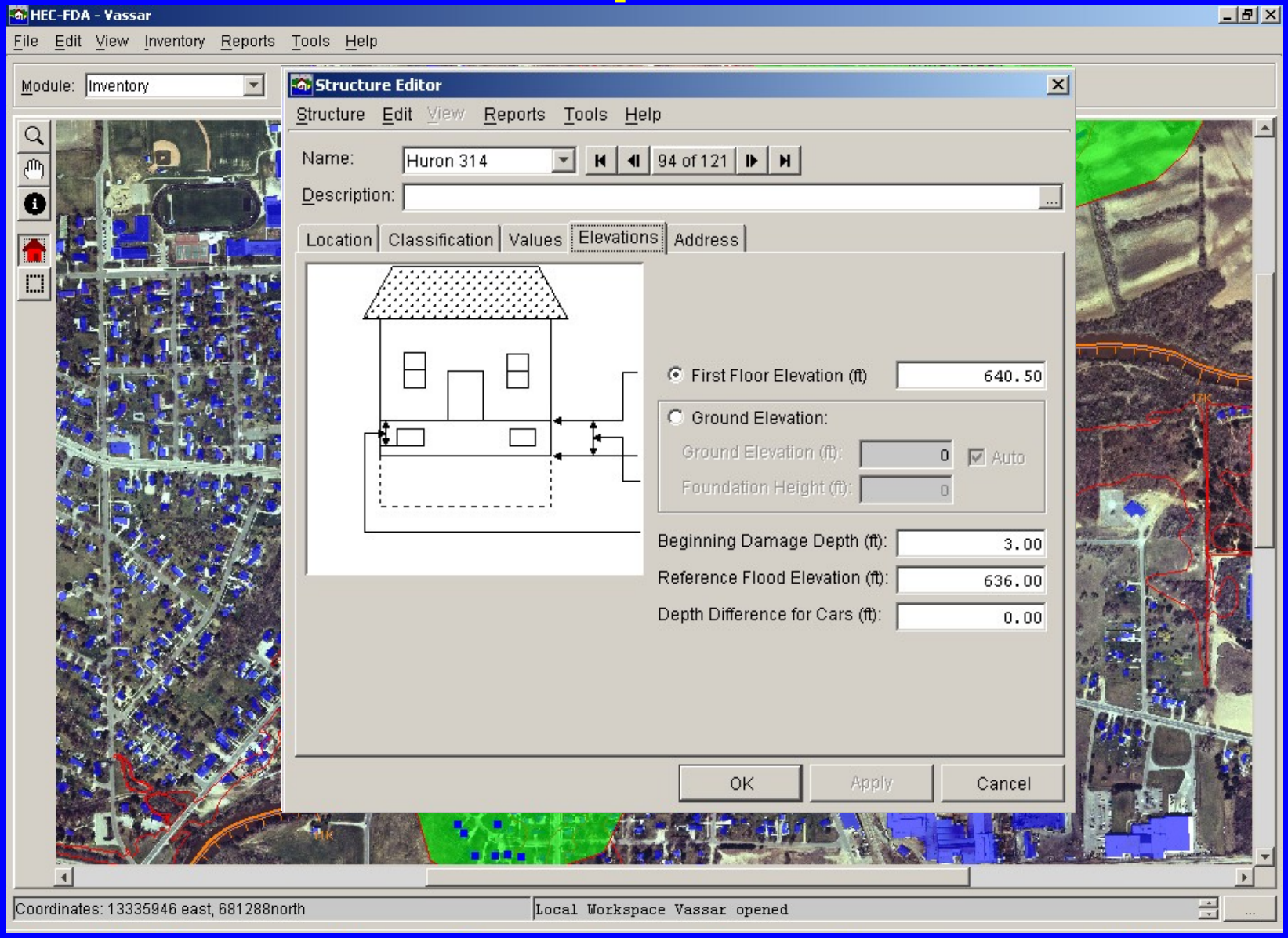
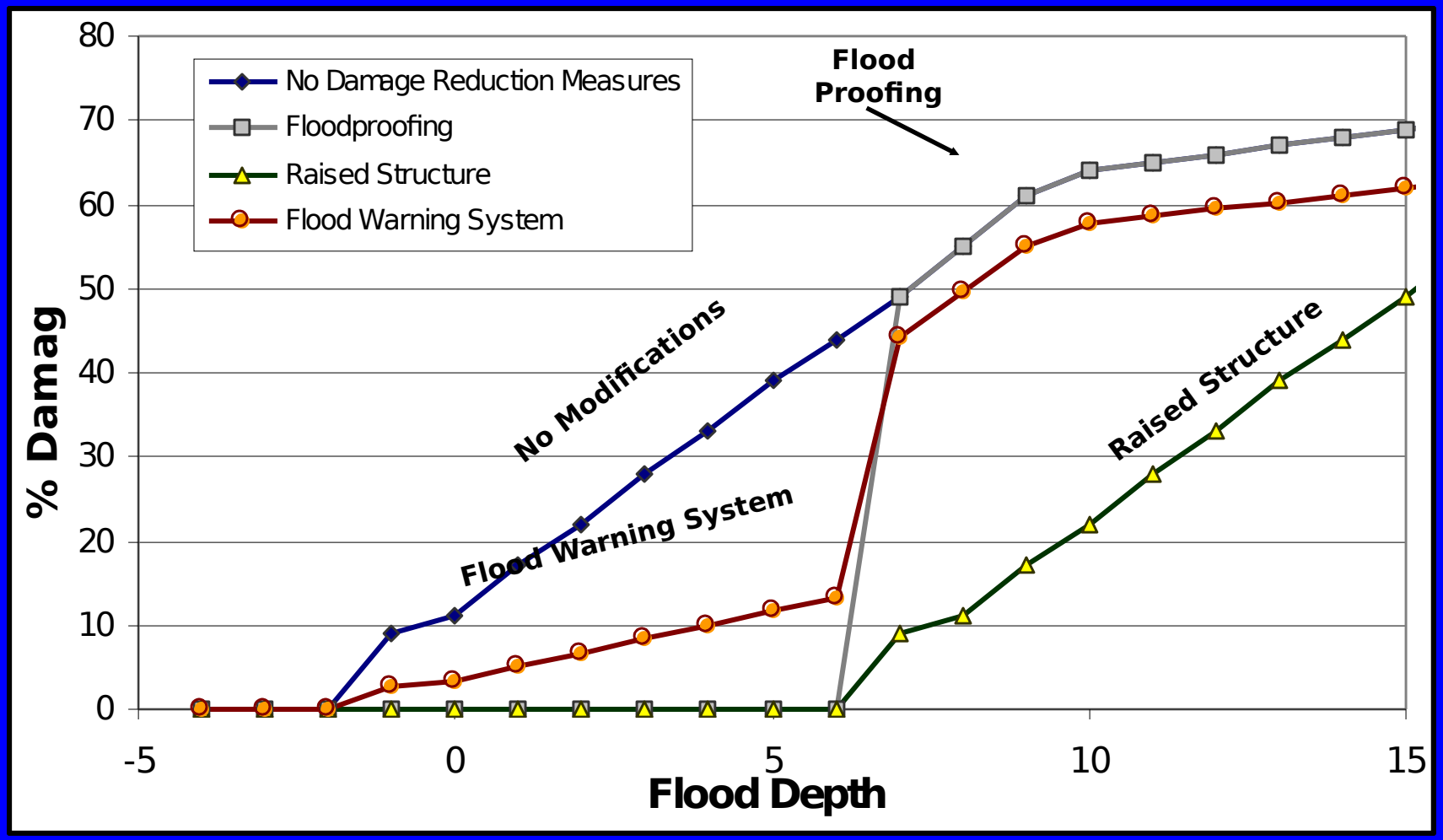
Shape Point
Strucname 035-18-11
Stream Tuolumne
Reach T3R
Station 87561
Bank Right
Category Commercial
Occtype Comm U 1 Story
Street OREGON DR
North 2052153
East 6422821
Totval 12720
Grndelev 78
Foundht 1
Zerodmgel 78
Dpth02 -31.87
Dpth05 -26.65
Dpth10 -24.82
Dpth25 -23.58
Dpth50 -14.07
Dpth100 -4.73
Dpth250 0.71
Dpth500 7.45
Dmg02 0.000
Dmg05 0.000
Dmg10 0.000
Dmg25 0.000
Dmg50 0.000
Dmg100 0.000
Dmg250 2111.913
Dmg500 7718.308
Notes WAREHOUSE
Clear
Clear All
Fppf_2.shp
Modesto_parcels.sh
Modesto.tif
YOSEMITE
Tuolumne Sch
AVE

HEC-FDA Geospatial Platform



Modifications Made to the Depth-%Damage Functions

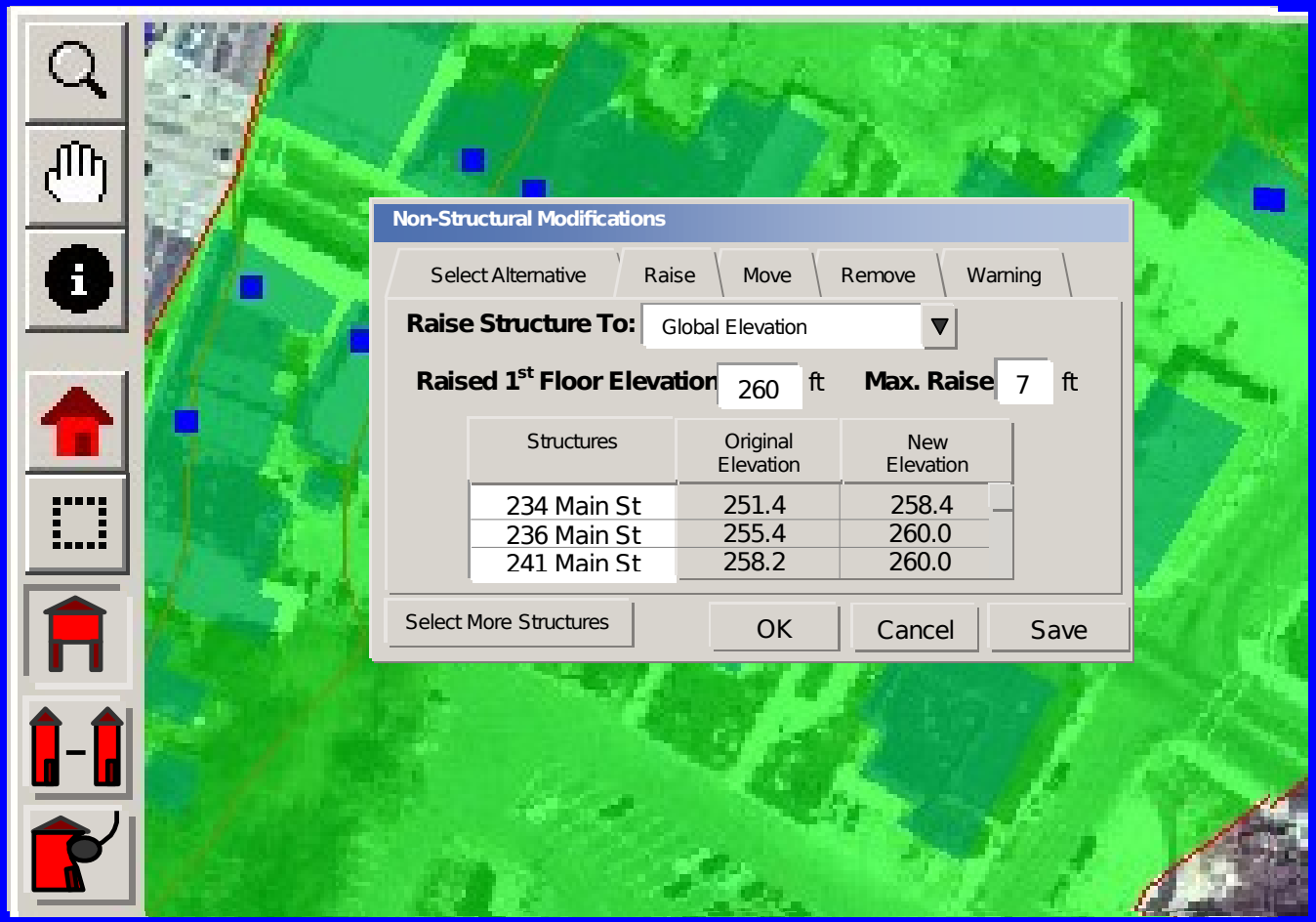


Interactive Module

- Will allow users to specify temporary nonstructural alternatives from an interactive GIS interface and compute revised EADs or event damages.
- Alternative sets can be saved as new structural inventories for complete risk analysis of the alternative.
- Will streamline the nonstructural analysis process and facilitate decision making.

Moving a Structure in HEC-FDA's Interactive Module

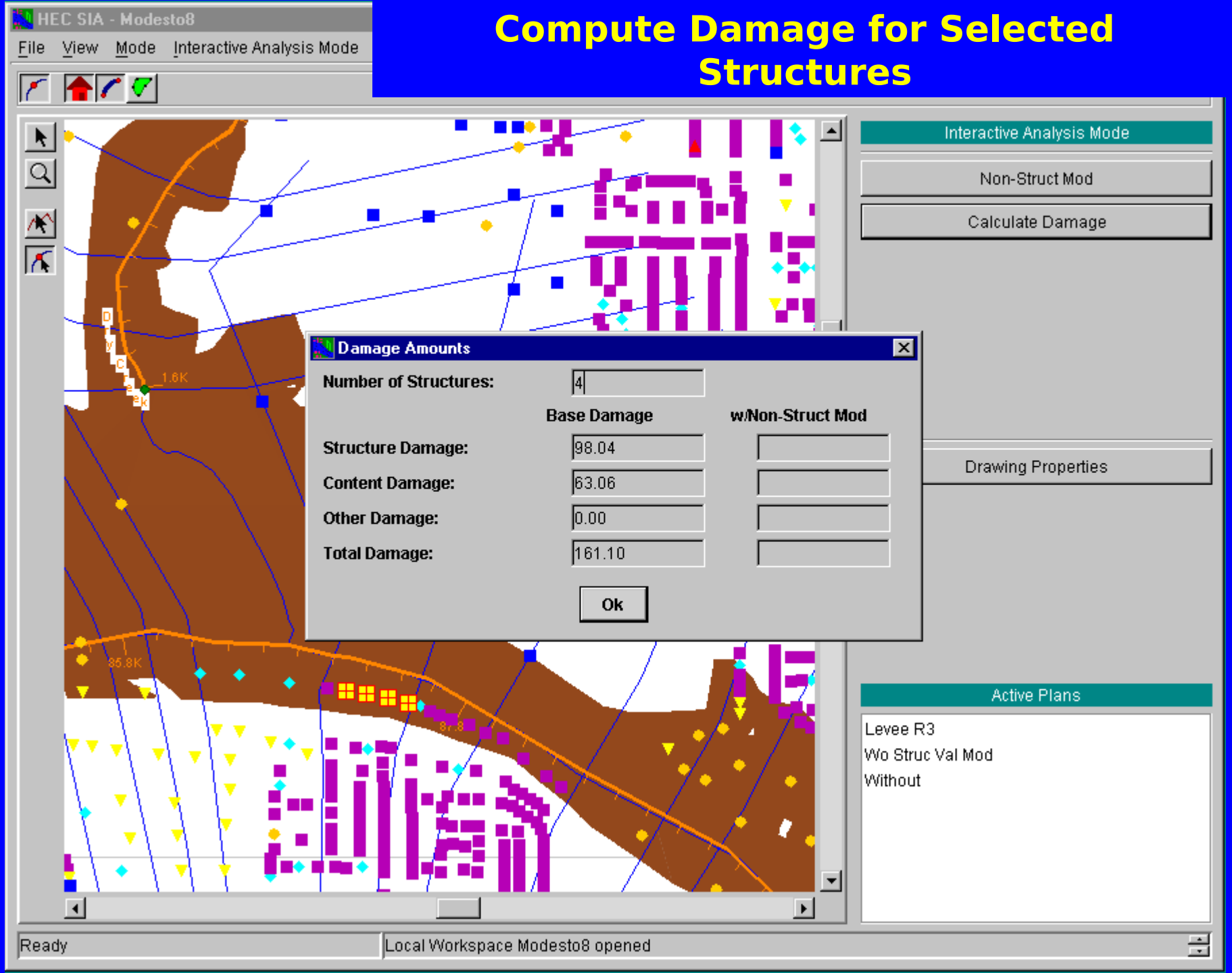
Raising Structures in HEC-FDA's Interactive Module



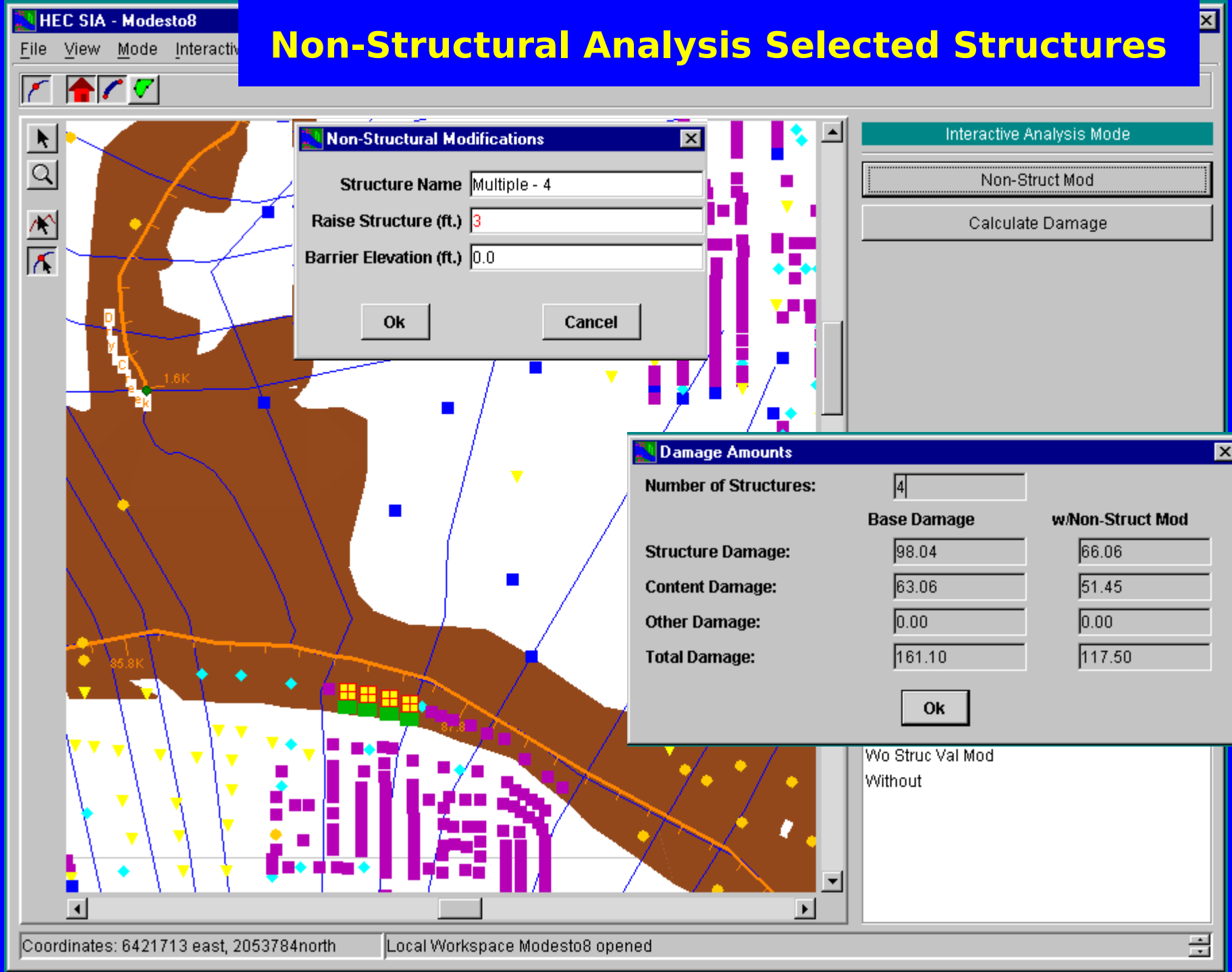
Placement of a Ring Levee in HEC-FDA's Interactive Module

Calculate a Revised EAD or Event Damages

Compute Damage for Selected Structures



Non-Structural Analysis Selected Structures



Prototype Study: Cass River in Vassar, MI

US Army Corps
of Engineers
Hydrologic Engineering Center

Investigation of Non-Structural Flood Damage Reduction Alternatives for the City of Vassar, MI.

August 2002

FR-52

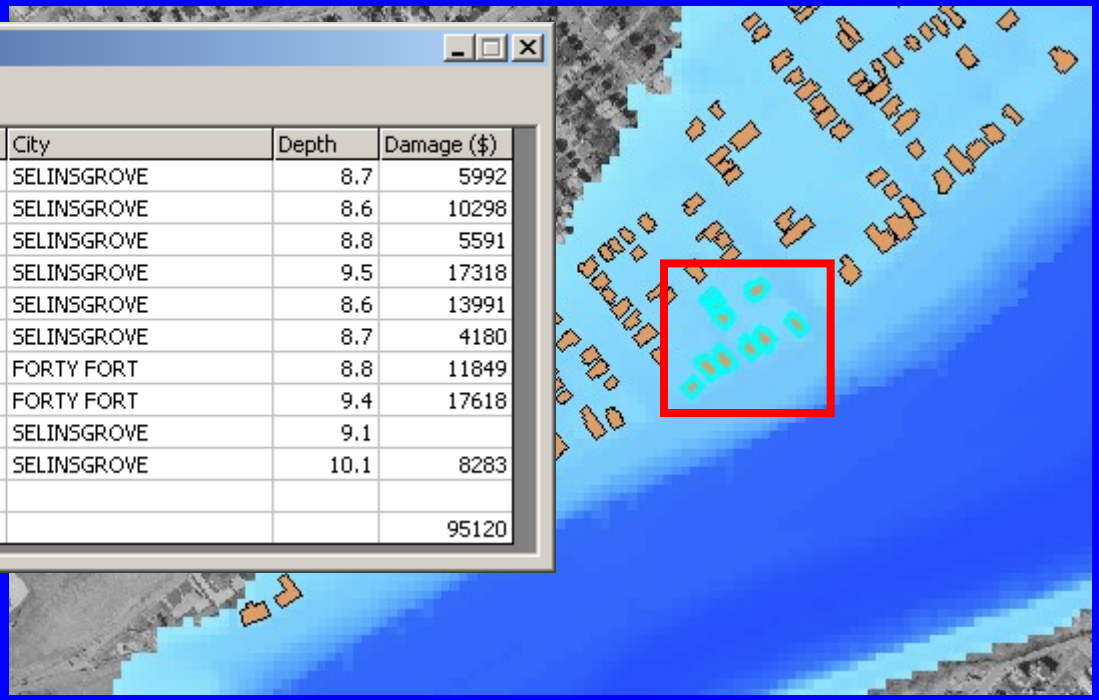
In cooperation with the National Non-Structural/Flood Proofing Committee and Detroit District

Susquehanna Flood Warning System Research for the Philadelphia District

Flood Damage by Structure

Print ... Copy ...

Name	Address	City	Depth	Damage ($)
KRATZER KENNETH A	216 PINE ST.	SELINSGROVE	8.7	5992
SMITH RICHARD W	316 PINE ST.	SELINSGROVE	8.6	10298
DANCIK WILLIAM J JR	301 PINE ST.	SELINSGROVE	8.8	5591
DORMAN EDWARD L	222 WALNUT ST.	SELINSGROVE	9.5	17318
INCH KAREN S	205 WALNUT ST.	SELINSGROVE	8.6	13991
HOFFMAN ROGER K	217 WALNUT ST.	SELINSGROVE	8.7	4180
KERN JEFFREY P & KATRINA A	268 RIVER STREET	FORTY FORT	8.8	11849
GOWER BETTY JEAN & DONALD	290 RIVER STREET	FORTY FORT	9.4	17618
WITMER CHARLES A	118 THIRD ST.	SELINSGROVE	9.1	
IRANI PHIKOZA	300 S. FRONT ST.	SELINSGROVE	10.1	8283
Total =				95120



Nonstructural Analysis in HEC-FDA

- Currently, “handcrafted” using HEC-FDA version 1.2, ArcView, etc.
- Goal: 1 October 2004
  - Alpha version of HEC-FDA version 2.0 that will allow some automation of non-structural analysis
  - Will be implemented in the “Event Analysis” portions of the program